

**A GIS AND ASSOCIATED DATABASE
FOR THE ITALIAN STRANDING NETWORK.
A COOPERATIVE PROJECT BASED ON GIS TECHNOLOGIES.**

G. Pavan ^{1,5}, M. Podesta ², A. D'Amico ³, N. Portunato ⁴, C. Fossati ¹,
M. Manghi ¹, M. Priano ¹, M. Quero ⁴, V. Teloni ⁴

1 CSC - Centro Interdisciplinare di Bioacustica e Ricerche Ambientali, Univ. di Pavia, Italy

E-mail gpavan@cibra.unipv.it

2 CSC - Museo Civico di Storia Naturale di Milano, Italy

3 SPAWAR - San Diego, California, USA

4 NATO Saclant Undersea Research Center, La Spezia, Italy

5 Department of Urban Sciences, IUAV, Venice, Italy

INTRODUCTION The "Centro Studi Cetacei" (CSC) is a research group established in 1985 at the Natural History Museum of Milan as part of the Italian Society for Natural Sciences. One of the most important projects of CSC was to create a national network (Italian Stranding Network) to collect data about stranded Cetaceans along the Italian coasts, or entangled in fishing nets, or found dead in open waters.

The Centro Studi Cetacei is recognized by the Italian Ministry of Agricultural, Food and Forest Resources, by the C.I.T.E.S. Office and by the Ministry of Environment (Nature Conservation Service). Since 1986 the Italian Stranding Network has been collecting data on more than 2600 strandings (>2700 animals), concerning 12 cetacean species, and has published regular annual reports. The dataset also includes 164 events recorded in the former project "Progetto Cetacei" as well as historical data found on literature and newspapers.

As it represents one the most comprehensive dataset available for the Mediterranean Sea, the Italian Stranding Network archive has been chosen as a case study of a Cetacean GIS application.

Stranding Networks in the Mediterranean Sea

Some of the Countries of the Mediterranean area have national cetacean stranding networks and keep databases encompassing either all or part of the coast. Other Countries have little or no coverage at all on stranding events.

The Italian stranding network is based on the cooperation of many subjects and Authorities. The Italian coastline (more than 8000 km) is divided into sixteen areas, each assigned to a member of the CSC who is in charge of the data collection related to the stranding and/or animal recovery.

The notice of the stranding is usually first reported to an urgency call-centre in Milan (sponsored by the insurance company Europ Assistance Italia). This information is promptly forwarded to the researcher in charge of the area in which the stranding has occurred. For each stranding event, basic data (species, number of animals, sex, location, etc.) and biological samples are collected to carry out biological and environmental researches. The main subjects analysed are: cause of death, levels of organo-chlorines and heavy metals in different tissues; accumulation and detoxification systems of mercury; bacterial and viral infections; enzymatic systems; parasites; age determination; diet; histo-physiology of the digestive apparatus; histology of the lungs and of the liver; osteology. Whenever possible, tissue samples are forwarded to the Cetacean Tissue Bank at the University of Padova.

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SOLMAR Databases

Data collected by CSC and by Progetto Cetacei, related to events from 1972 to nowadays, have been geographically referenced and organized in a database. This database is the core of a Mediterranean and Black Sea Cetacean GIS. This GIS is being developed within the NATO Saclantcen SOLMAR (Sound Oceanography and Living Marine Resources) Project.

SOLMAR is an international interdisciplinary program that investigates underwater noise and its effects on marine environment. This program is sponsored and developed by NATO Saclant Undersea Research Center based in La Spezia, Italy. It includes the development of a whole set of databases containing oceanography, ecosystem dynamics and marine organisms of the Mediterranean Sea. The program is aimed at developing models for predicting presence of marine mammals according to environmental parameters.

To comply with SOLMAR objectives, datasets were expanded to include strandings from other areas of the Mediterranean Sea, Black Sea and adjacent waters, when available. This was made by browsing literature and contacting researchers involved in other stranding networks, though it is clear that the coverage of the Mediterranean Sea made by stranding networks is incomplete and many unpublished partial datasets may still exist.

The GIS for the Italian Stranding Network

SOLMAR databases were first organized by entering data reported by CSC and other older records. The records were cross-checked with the original documentation kept at the Natural History Museum of Milan. By browsing through the original documents it was also possible to add unpublished details.

The database includes information about the number of animals, the species (or the genus when identification was impossible), size and sex, the status observed when the animals were found (alive, dead, decay status), the injuries observed on bodies, the hypothetical or proved cause of death, the treatment and release condition in case of animals found alive. Together with the described fields, information to track the biological samples (tissue, skeletons, etc.) and the final disposition of the bodies were included.

The position of each stranding was then searched on detailed maps to be accurately georeferenced. As most of the records reported local names only, it was often difficult to associate them to precise locations and official place-names. In some cases, the coordinates were assigned according to the central point of the coast pertaining to the municipality in which the event was reported.

Datasets were transferred to ArcView 3.1 for plotting and for a further phase of cross checks. Recently, to provide CSC researchers with a low cost solution for data archiving, display and analysis, data were transferred from ESRI ArcView to a less expensive GIS (Manifold 5) also. To further improve the analysis potential of Manifold 5, custom scripts and VBA modules have been developed to make data analysis quicker. Basic queries allow plots of the distribution of events by region, year, species, number of animals, cause of death, data source, etc. To satisfy specific requests, advanced queries and reporting can be easily added.

To set up the physical oceanographic part of this GIS, the IBCM bathymetric contours distributed by British Oceanographic Data Center (BODC, UK) were used. Contours were transformed into suitable formats using a custom developed software.

A broader approach Mediterranean sea life is heavily endangered by habitat degradation deriving from human activities. Fishing, heavy ship traffic, biochemical and noise pollution, coastal anthropization are constants in the Mediterranean area.

The GIS approach not only helps for data visualization, but it also helps understanding spatial and temporal distribution of stranding events, their causes and their relationship with other oceanographic, environmental and population parameters. By integrating sightings, acoustic contacts and stranding data in the GIS, it will become an important tool for cetacean distribution studies in relation with environmental parameters, for identifying critical habitats, for evidencing critical environmental issues, and for defining conservation and management guidelines.

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WEB REFERENCES

Cetacean Tissue Bank	http://digilander.iol.it/cetaceantissuebank/
CIBRA	http://www.unipv.it/cibra
CSC	http://www.centrostudicetacei.org
ESRI	http://www.esri.com
GEBCO	http://www.bodc.ac.uk
Manifold	http://www.manifold.net
Museo di Storia Naturale di Milano	http://www.rcs.it/mimu/musei/musei.htm
ONR	http://www.onr.navy.mil
SOLMAR	http://solmar.saclantc.nato.int

Table 1 - Table showing the contents of the database: stranding data earlier than 1986 represent less than 10% of the dataset.

	Whole database	Italian waters and coast	Italian waters and coast by CSC
N. of stranding events			
1840-1985	264	200	-
1986-1998	2379	2335	2322
1999-2000	292	292	292
total	2935	2827	2614
N. of animals			
1840-1985	321	246	-
1986-1998	2511	2452	2438
1999-2000	294	294	294
total	3126	2992	2732

Table 2 - Amount of data now available in the database/GIS, species by species. At present only data about Cuvier's beaked whales cover the whole Mediterranean basin. Undetermined species (>600 cases) are not reported in table. The numbers related to striped dolphins are influenced by a morbillivirus infection happened in 1991; in that year the strandings doubled the values of previous years.

List of species recorded (1840-2000)	Number of strandings		Number of animals	
	Other seas	Italy	Other seas	Italy
Physeteridae				
<i>Physeter macrocephalus</i>	-	144	-	167
<i>Kogia simus</i>	-	1	-	1
* <i>Kogia breviceps</i>	1	-	2	-
Balaenopteridae				
<i>Balaenoptera acutorostrata</i>	-	8	-	10
<i>Balaenoptera physalus</i>	2	65	2	65
Delphinidae				
<i>Delphinus delphis</i>	-	43	-	43
<i>Globicephala melas</i>	-	44	-	51
<i>Grampus griseus</i>	-	112	-	120
<i>Orcinus orca</i>	-	1	-	1
<i>Pseudorca crassidens</i>	-	4	-	5
<i>Stenella coeruleoalba</i>	2	1223	5	1280
<i>Tursiops truncatus</i>	-	497	-	502
Ziphiidae				
<i>Ziphius cavirostris</i>	92	75	117	87
* <i>Hyperoodon ampullatus</i>	1	-	1	-
* <i>Mesoplodon</i> spp.	10	-	10	-
* Canary Islands <i>Mesoplodon</i> spp. include <i>M.europaeus</i> , <i>M.bidens</i> , <i>M. densirostris</i>				